ASSESSMENT COMMITTEE

National Space Weather Program

26 September 2005

Mr. Samuel P. Williamson
Federal Coordinator for Meteorology
Chair, National Space Weather Program Council
Office of the Federal Coordinator for Meteorology
8455 Colesville Road, Suite 1500
Silver Spring, MD 20910

Dear Mr. Williamson:

In accordance with the charge from the Federal Committee for Meteorological Services and Supporting Research (FCMSSR), a National Space Weather Program (NSWP) Assessment Committee has been formed under the auspices of your Office. This Assessment Committee had its organizational meeting in July 2005. At that meeting the Committee heard presentations from, and engaged in discussions with, the four Federal agencies that co-chair the Committee for Space Weather within the Office of the Federal Coordinator for Meteorology: NSF, NASA, NOAA, and the DoD. The Committee began planning its subsequent activities, including visits to key agency individuals and other Federal organizations involved in the nation's space weather enterprises. The process for completing an informative web site for the NSWP was decided, and the site was subsequently launched (http://www/nswp.gov). The Committee began devising a questionnaire to be distributed widely to the interested community concerning current involvement with, and knowledge of, the NSWP. The finalization of this questionnaire was completed by extensive Committee email exchanges. The questionnaire (http://www.nswp.gov/nswp_comminput.php) was posted on two research-oriented web sites (the American Geophysical Union's *SPA News* and the American Astronomical Society's Solar Physics Division *Solar News*) as well as a news item in the journal *Space Weather* (http://www.agu.org/journals/sw/). Responses to the questionnaire continue to be received and will be analyzed as a part of the Committee's subsequent responsibilities.

The Assessment Committee had a second series of meetings in mid-September, including a discussion with you of its work to date. At these meetings the Committee engaged in additional discussions with NASA and NSF, had a discussion of the NPOESS Program, had a presentation from the Navy, visited the National Security Space Office and the Air Force Director of Weather in the Pentagon, and had a meeting with the Advanced Systems and Technology Directorate at the National Reconnaissance Office. The Committee has not had sufficient opportunity to assimilate all of the information received during the September meetings, and thus this Interim Report does not reflect all of the substance of this second series of meetings.

This Interim Letter Report of the Assessment Committee is composed of five Findings that arose principally from the initial discussions of the committee with the co-Chair agencies and from the Committee's subsequent internal analyses and correspondences. It is likely that many of the

issues dealt with in the following five Findings will be further addressed in the Committee's final report, after all of its fact-finding has been accomplished and synthesized.

Finding #1. National Space Weather Program. *Over the last decade, the National Space Weather Program has developed into a multi-agency activity that involves four principal agencies that serve as co-Chairs of the Committee for Space Weather, and three additional agencies.*

The United States NSWP began ten years ago as a collaborative enterprise between the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the Department of Defense (DoD). These four agencies currently co-Chair the Program. Other agencies who participate include the Department of Energy (DoE), the Department of the Interior (DoI), and the Department of Transportation (DoT). The NSWP has operated under the auspices of the Office of the Federal Coordinator for Meteorology (OFCM: http://www.ofcm.gov).

The Program is based upon several documents (http://www.nswp.gov/nswp_docs.htm), including a 10-year Strategic Plan, approved in August 1995 (http://www.ofcm.gov/nswp-sp/text/a-cover.htm), and an Implementation Plan, the first published in January 1997 and the second in July 2000 (http://www.nswp.gov/images/nswpip2000.pdf).

The latest Implementation Plan is now more than five years old. Policy considerations and research and user understandings related to space weather and national interests continue to evolve. While it is early in the activities of the Assessment Committee, it is likely that the committee will be able to support a recommendation in its Final Report (to be delivered early in CY2006) that new Strategic and Implementation Plans (including the need for an examination of infrastructure issues) will be necessary.

One of the important tasks of the Assessment Committee is to understand the current level of commitment for the program in the participating agencies as well as in the space weather community at large – public and governmental. The Committee is using visits to the several agencies and entities as well as targeted questionnaires to address this task and to formulate possible recommendations.

The NSWP has stimulated to date several important initiatives that have cross-agency support and sponsorship. These include the initiation of the technical magazine *Space Weather: The International Journal of Research and Applications*. This electronic technical magazine (with a hardcopy Quarterly edition) is currently published by the American Geophysical Union and is composed of peer-reviewed technical articles and reviewed shorter Feature Articles, News, Commentary, and Editorials (http://www.agu.org/journals/sw/). NASA and NSF currently support, with some computer capabilities furnished by the DoD, a Community Coordinated Modeling Center (http://ccmc.gsfc.nasa.gov/) for the evaluation and transfer to applications of space weather models. NASA has initiated the Living With a Star (LWS) program, a space weather-focused and applications-driven research program (http://lws.gsfc.nasa.gov/)

Finding #2. Space Weather in the Nation. *Space weather impacts and services are of increasing importance to a growing and diverse user community – both government and private sector.*

Attendance and participation in the annual national Space Weather Week that is held in the early spring and sponsored by the NOAA Space Environment Center (SEC) demonstrates the continued interest in the subject by a wide range of researchers and by the user community. The interested user community continues to expand. For example, a prominent user group with enhanced participation at the most recent (April 2005) meeting was from the civil airline transport industry. The interest here is dominantly those airlines with trans-polar routes with concern related to the charged particle radiation that can be present at airline altitudes over the polar caps (principally the northern polar region) following major solar activity.

While there is considerable interest in space weather in the user and research communities, there is uncertainty by the Committee as to the current level of interest or understanding of the relevance to national interests that the subject has at important governmental policy levels. The Assessment Committee hopes to achieve a better understanding of this and to be able to provide advisory guidance to the NSWP.

The enhanced user interest has continued to feed the interest in the private sector in the supply of tailored space weather products to supplement and enhance the public products that are available from sources such as the SEC. The tensions between public and private sectors at times mirror those that have been existent in the atmospheric weather community for decades, and often lead to creative and enhanced responsiveness to user needs and requirements. At the same time, the public and private sectors are wise to work creatively to minimize tensions that might be detrimental to users. These tensions and related issues were addressed, with some suggestions for amelioration, in a chapter in the decadal survey of solar and space physics, *The Sun to the Earth and Beyond: a Decadal Research Strategy in Solar and Space Physics* (http://www.nap.edu/catalog/10477.html).

There remains a serious absence of good metrics to assess adequately the seriousness and the magnitude of space weather effects on various technical systems, both private and public. This absence of adequate metrics often results from the reluctance on the part of the private sector in numerous industries to share data that could be used adversely by a competitor (even if all in an industry might be suffering similar problems). In the national security sector, classification of anomaly data does not allow a wide and diverse examination of space weather effects or of the quantification of the impact magnitudes. For these and related reasons, it is thus often difficult to obtain independent assessments as to the cause(s) of some technical anomalies that might have a space weather origin or component.

Finding # 3. The Academic Community. *The academic community has participated in the NSWP principally through research programs (funded by NSWP agencies), including some programs that are beginning to result in the transfer of prediction and operational tools. The academic community may be unaware (or only partially aware) of the broader importance and relevance of the NSWP to national interests.*

This finding is closely related to Finding # 4, below. There are major efforts underway in the academic community to construct usable models for portions of the solar-terrestrial system, as well as for more global Sun-to-Earth models, all of which are designed to address user needs and concerns. Among these efforts are several major modeling centers that have been supported by the DoD and the NSF. The DoD has supported three Major University Research Initiatives (MURIs) that address important space weather modeling problems, as well as the development of

an undergraduate-level textbook on space weather. The NSF has awarded one of its grants for a National Science and Technology Center to a multi-university, multi-institution activity devoted to creating a physics-based numerical simulation model that describes the space environment from the Sun to the Earth.

It is uncertain if the wide academic community is adequately aware of the driving issues that can face public sector users. In addition, the private sector, that might be able to use some of the developments in the academic community, often remain unaware of the academic efforts and/or skeptical of the applications of these efforts to their problems – often because of concerns of the security of intellectual property when shared with academia.

It is not clear as yet to the Committee as to whether the professoriate and university researchers involved in space weather research are well-attuned to the national public and private user interests and can adequately convey these interests to their students and research staff. It is important to the national interests in, and importance of, space weather that academia ultimately views research announcements and opportunities from the NSWP agencies as more than just another research funding source; that is, as a Program that is expected to have some ultimate payoff in practical utility – public or private.

Finding # 4. Research to Operations. *Science and technology transfer from research to operational use is occurring, but appears to be woefully inadequate in the views of the users in the operational agencies.*

As mentioned above, the Community Coordinated Modeling Center (http://ccmc.gsfc.nasa.gov/) has been established as a "multi-agency partnership to enable, support, and perform research and development for next generation space science and space weather models". This activity appears to be operating in a quite cooperative manner with model builders and the user community. Nevertheless, as most all participants and observers would relate, the transition of models and concepts to the user communities remains fragmented and at times problematical. One important problem would appear to be the absence of standards as to how to incorporate modules from various sources into models. Another important problem would appear to be the inadequate capabilities of the relevant public sector user groups to make use, let alone optimum use, of the capabilities of new research understandings and models.

The difficulty in coupling of research activities to more practical usage is not confined by any means to space weather, or to the public sector. A consistent conundrum in research management remains the problem of how to enhance and speed the transfer of new research to practical use and into viable products (which translates into profitability in the private sector). The converse of this conundrum also holds: how to get researchers interested and involved in a real-world practical problem (whose solution even might result in new fundamental research understandings). The difficulty of achieving this latter goal can be greatly exacerbated when there are classification or intellectual property issues at stake.

Finding #5. Data Availability and Assimilation. *There is a perceived need in the operational agencies for better multi-agency data collection cooperation and cost sharing for a number of types of data that are critical for assimilation for space weather prediction and operation.*

A number of agencies are supporting data gathering and dissemination from various size arrays of instruments (including space-based instruments) that are relevant to addressing practical space weather problems. However, the accessibility to data from these instruments is not always easy or optimum across agencies, as well as into the private sector. There also appears to be no readily available means (or comprehensive central source) for individuals and agencies to have knowledge of what data may be available for validating models or assimilating into models for predictive purposes, or for other purposes. The improvements in forecast accuracy derived from data assimilation algorithms in the terrestrial weather regime can not be tapped for the space weather regime without access to regional and global data sets. It is not clear how (or if) decisions for funding new instrumentation and instrumentation types take into account current and projected needs and requirements of space weather users and modelers, and of the possible requirements of other agencies.

In summary, the National Space Weather Program has made major advances over the last decade. As the findings above indicate, there remain major challenges for the Program as well. The Assessment Committee will examine further the issues raised in the above Findings as well as others that arise in the course of its examination of the Program, will examine the Program further in the context of its Terms of Reference as established by your Office, and will propose appropriate recommendations in its final report to your Office.

Sincerely,

Louis J. Lanzerotti, Chair
Daniel N. Baker
Tammy E. Jernigan
Robert J. Rizza, Executive Secretary
Delores J. Knipp
Ray A. Williamson
S. Pete Worden